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ABSTRACT

Whether or not environmental concerns provide a visable and continuing basis of university organization is the situation scrutinized in this speech. Apparently part of the problem has been the generation of some theme or model around which a core of interested faculty and students could work. It is implied that some conceptual organization of an environmental studies program is the fundamental task for providing a common theme for the disparate disciplines. Measurement (of problems) is not enough of a common theme; some matrix of substantive relationships is required. We have left behind an era with ideas like recycling of aluminum cans and are entering an era concerned with understanding the interrelationships of consumption patterns, with population, and with pollution, and whether or not technology is leading us in the direction we want to go. Additional essentials for university organization of an environmental studies program include some kind of status in the university hierarchy; a Bill of Rights or authorities for faculty in environmental studies; and flexibility in the format of teaching and the manner in which teachers prepare for interdisciplinary studies. (BL)

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UNIVERSITY ORGANIZATION FOR ENVIRONMENTAL EDUCATION

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The environment as an issue of national concern and as a basis of national policy is now thoroughly established in the United States. Much emerging legislation in congress and the state legislatures is directly related to environmental policy.

American universities, in their history, have been strikingly responsive to national issues and needs. So they have been on matters of the environment. A scrutiny of college courses and research programs would probably reveal a near revolution in the content of higher education in the last decade.

Whether or not environmental concerns provide a viable and continuing basis of university organization is still in doubt. I say this, in spite of the fact, that 62 of 85 universities indicated some sort of newly-created academic units for environmental studies in a survey conducted by the National Association of State Universities and Land Grant Colleges in 1972. There are without doubt many more than 62 such new organizations.

Why then, doubt about the environment as a means of organization or of reorganization in universities? The word reorganization probably gives more of a clue to the problems and issues than does the word organization.

The environment is an exceedingly encompassing theme. It touches virtually every academic citadel. It oozes through the disciplinary boundaries. It appears to have no boundary of its own. Some feel it threatens the disciplinary boundaries as well as the budgetary boundaries of departments. Clearly, this issue has the potential for major upheaval in academia.

Because of the fundamental importance of environmental issues in coming decades, I am now convinced that American universities must assemble energy and talent to deal with these issues.

Part of the problem so far has been the generation of some theme or paradigm around which a core of interested faculty and students could work. The history of the environmental movement gives us some clues about how this is being done in the universities.

The environmental movement's ancestors include the conservation movement and the pollution abatement movement. The concept of conservation of natural resources has a long history in the U.S. It has tended, in universities, to be concentrated in schools of natural resources and in resource management departments. The movement has its leading scholars, its testaments and its commandments. The pollution abatement movement evolved somewhat separately in the U.S. In universities it has tended to be concentrated in departments of civil engineering with some input from economics and law. Both of these movements have had characteristics of interdisciplinary study.

In recent years there have been a number of attempts to combine the conservation and pollution abatement forces, outside of universities, into unified administrative and policy structures, ie., the combining of departments of natural resources and water and air quality control organizations. This attempt to combine has not yet occured at the federal level. Conservation tends to be concentrated in the Department of Interior and pollution abatement in the Environmental Protection Agency.

There has been a third congregation in the universities, gathered around the concept of ecology. In my opinion the ecology movement has not been widely successful as a means of organization outside the university, although ecologists have been successful as antagonists or intervenors in the environmental decision-making process.

In a sense the conservationists, the pollution abaters, and the ecologists are dealing with symptoms of some underlying environmental problems. This is

not to demean their ideas or their efforts. But to argue against the depletion of a resource, the pollution of a watershed, or the degradation of an ecosystem is to deal with the results rather than the root issues.

At least one American university is currently planning a graduate training program around Environmental Impact Analysis. This is an admirable idea, and we certainly need people well-trained in this area. But in a way, the idea is twice removed from the real issues. It is in fact, training in the measurement and monitoring of phenomena that are symptoms. This will be successful, provided the real etiology of the environmental problems are described as a basis for what is essentially monitoring.

Is there some way, then, to define the driving forces in environmental problems that can give us more perspective about what is happening?

I would like to suggest one such organizing theme; not the only one, certainly, but one which might give a basis for a solid organization of interdisciplinary study.

Can we treat some of these elements in a systematic way, even as a system.

If one writes down the theme words in the environmental movement, the list includes pollution, resource consumption, population (or over-population), technology and man-machine relations, energy use, social and cultural problems, the economics of consumption, land use, and wilderness and endangered species. In fact, this list is very similar to course listings in many environmental studies programs in the country.

Let us consider pollution first. Most pollutants generally are not different in kind than those that have been entering ecosystems for millenia. Synthetic chemicals, of course, are an exception. The point here really is that pollution is not the addition of wastes to the environment per se but the addition of these wastes faster than the ecosystem can recycle and disperse them, resulting

in intolerable or undesirable concentrations. Thus, we evolve a concept of pollution concentration and we have built a bridge between pollution and land use.

This reminds me of a discussion I had recently with a group of Japanese businessmen on a trade mission to the United States. The Japanese argued, with some force, that the per capita consumption of energy in the U.S. was at least twice as high as in Japan. Thus, would the U.S. be willing to give up some of its energy resources upon demand from perhaps some of the oil from Prudhoe Bay.

My counter-argument had to do with population density on the land. Japan, nation-wide, is four times as densely populated as the U.S. If their energy consumption per capita were equal to ours, then the pollution load, figured in terms of area would be at least 8 times greater than ours.

What kind of pollution-abatement technology would be required to handle that problem?

But I am getting ahead of my logic.

We would suggest that pollution production is a function of population density (persons per square mile) times resource consumption rate (per capita per year), times some appropriate technological loss factor.

Let's take an example. Suppose we are concerned with increasing sulfur dioxide as a result of national policy that turns more to our coal reserves rather than relying on oil. We can multiply our population density of about 60 people per square mile, by the per capita annual consumption of about 11 tons of coal, times a factor of about .06 which represents the sulfur dioxide equivalent of the average sulfur content of the coal. To get some measure of the pollution load, we can calculate total pollutant addition per acre as the sum of individual pollutants. The total pollutant addition for the whole nation may be calculated simply by using the population figure for the whole nation

instead of the population per square mile. The validity of the equation is independent of whether the pollutant ends up in the air, in water, or as a solid waste to be buried.

One can write a similar equation for energy. Our requirements for energy are a function of population, times resource consumption, times a technology efficiency factor.

The logic I am expressing here is that pollutant production and energy use are related to population, resource use, and technology. They are related to each other through the common variables. One cannot discuss changes in pollutant production without considering population, resources, and technology, and hence energy use. Further it is clear that we can change rates of pollution production only by manipulating population, per capita resource consumption patterns, technology, or some combination of these.

These relations discussed above also provide a vehicle for considering some of the ways that men and their machines cause environmental problems.

In the sense that man today does not exist in the absence of his culture, the man=machine division is somewhat artificial, and the two can be combined, for some analytical purposes, into a man-plus-machine combination that varies from culture to culture. Machines can be equated as people. Machines eat raw materials and fuel, breathe in order to oxidize fuel, and excrete. We rarely provide sewers to handle the machine metabolic by products and we dump raw sewage from many machines directly into the environment.

What then is the equivalent population of the United States or of any other country not just in terms of people but in terms of people and the machine man-equivalents, all of which excrete pollutants which must somehow be handled. A simple way to calculate the man-equivalent of machines is to compare the amounts of power used by man with the power used by machines. The U.S. per capita energy consumption is about 86,190 kwh/yr. Each American uses about 79 man-equivalents of energy, ie., he has nearly 79 energy slaves working for

him. In these terms, the population of the United States is 79 times 200 million or 15.8 billion man-equivalents. This, we argue is the real population density in a pollution abatement sense. The per square miles density of energy slaves in the U.S. is 4,480. The per square mile energy slave density in India is 615. This is also the technological gap between the two countries.

One can carry this analysis further. The equations are, we admit, primitive. But we suggest they provide an analytical framework for interrelating phenomena such as resource consumption, including energy, with population trends, and pollution. The equations do not deal with questions of what kind of quality we want in our environment. The analysis does show the extent to which the United States, with our current rates of consumption, is frighteningly dependent upon energy. It also shows that further population, or further increases in per capita uses resources will require vast quantities of energy. This trend certainly must be one reason why the U.S. suddenly finds it self trying to puzzle out shortages of some of the basic resources, including energy.

We are using some of these concepts of interrelationships in one more specific research program at Wisconsin which I will only mention briefly.

It is clear that world population is in an ominous footrace with food supplies. In the last decade we have pumped increasing amounts of resources into food production. Some countries, notably, Russia, China, and Japan have been able to increase the quality of their diets. Some of this production increase is indigenous, produced at home. But it is also obvious that pressure for North American food supplies is increasing. We have achieved increases in food production for a series of technological reasons. But a most striking figure is that we are now using, in our food production system in the U.S. about 9.5 calories of fossil fuel to produce one calorie of food.

Beyond that, there are some rather strong indications that world climate

conditions are changing to a less favorable regime for food production. The African drouths are very likely a function of these climate changes, changes that appear to have the ability to persist. Whether or not the climate will be a limiting factor, we should expect to have to increase the resource inputs into food production due simply to population increase. The ratio of fossil fuel calories to food calories will be a crucial one.

The overview problem is the resiliency of technology to environmental change, whether caused by pollution or not. Our research is concerned with climate forecasting tied to productivity responses in agricultural systems.

I would like to turn my attention now to some analysis of university organization for environmental studies. I have strongly implied that I think some conceptual organization of an environmental studies program is the fundamental task for providing a common theme for the disparate disciplines. It seems to me that measurement is not enough of a common theme. Some matrix of substantive relationships is required.

In preparation for this meeting and to assess our progress at Wisconsin in environmental studies, I have just completed a visit to several campuses that have had several years' experience in this arena. I am not going to name those campuses specifically so that I can comment frankly on strengths and weaknesses as I see them. Some strengthes and weaknesses in Wisconsin's program will be woven into this analysis, but hopefully you won't be able to identify those either. I will also rely on some knowledge of programs I did not visit on the trip last week.

Most environmental studies programs have grown out of the convictions of a relatively small group of able faculty who sometime in the last decade committed themselves and their university careers to the serious environmental problems they saw emerging around them. Part of their conviction was that a

University should address itself to the community, the commonwealth, the nation and environmental problems. This philosophy had and still does exist in professional colleges, for example agriculture, engineering, and health, but the colleges of liberal arts have not always had the idea of problems as the proper concern of higher education. The environmental programs have, however, tended to emerge as interdisciplinary programs from the liberal arts and sciences faculty. This is not to say that the professional schools have not been interested, they just haven't been the revolutionaries willing to experiment with new university configurations.

In some cases, new university campuses were born about the time that the environmental movement gathered force. They have had the unique opportunity to set their own patterns of organizational crystallization and have not had to compete with highly-organized departments and colleges. Their development has not been easy, however, because there are magnetic forces pulling faculty back to disciplines even in the experimental campuses.

The programs that have been started on existing campuses tend to reflect the strengths and expertise of the innovators. The programs tend to be limited to the constrictions of the campus, for example where a university mission statement limits a program to undergraduate education. In other cases the leadership has intentionally limited the program to either undergraduate programs or graduate programs, or research, depending upon the configuration on the campus or the strengths of the competition. There are few programs that have pushed forward in undergraduate education, graduate education, interdisciplinary research, and public education. This is a large task. But I'm sorry this is not occuring more often because interdisciplinary environmental studies would appear to me to need all of these functions even more than the traditional disciplines. My reasons for this position is that environmental field problems lend themselves

to movement between instruction and research. Budgeting will surely improve as the community senses university contributions to solution of environmental problems.

One campus I visited is limited to undergraduate programs. Through field work, it seemed to me that the faculty was treating undergraduates like graduate students; they were in fact conducting research and producing papers. That will work well depending upon the competence of the undergraduates.

My general impression is that there are a number of successful courses, field research projects, and core graduate studies programs evolving at whatever level. There is much discussion about career opportunities. While I think this is a matter of some concern, I also see the career possibilities unfolding.

There seems to me to be some weariness among faculty who are on the one hand struggling with the development of the very tough teaching concepts and on the other hand manning the barriers against real or imagined attacks from the disciplines.

My feeling now, perhaps colored by the construction of environmental themes at Wisconsin, is that we have left behind one era in the environmental movement at the universities and have entered another. The era behind had to do with ideas like recycling of aluminum cans, although this is still important. The era we are entering is concerned with understanding the interrelationships of consumption patterns, with population, and with pollution. And whether or not technology is leading us in the direction we want to go. The rigor this configuration will supply is a new capacity to predict the future in large, complex systems. We see these predictions beginning to emerge in places like MIT and Dartmouth, University of California-Davis and other places.

One comment from a faculty member in my recent trip illustrates the basic hurdle that must be overcome, in my opinion. Students on his campus can major

in environmental studies and there are a number of new interdisciplinary courses. I asked the professor if the students had what I would call a background problem. That is, do they understand enough chemistry, physics, math, and biology in the natural sciences, and enough economics or sociology in the social studies to deal with and even challenge the concepts that are used in the confrontations of special interests in environmental concerns. His reply, "80% of our students are scared to death of chemistry, math, and physics."

In an earlier speech sponsored by Southern Illinois University, I talked about the Case for the Rigorous Generalist. In fact, that was the title of the speech. The problem is still with us. I don't mean to imply that rigor and discipline are synonymous. There can be an interdisciplinary rigor, a fact I didn't fully realize in that earlier speech. The interdisciplinary rigor is, however, what the word says inter-discipline. It must be the blending of the best of some combination of disciplines.

Now I would like to discuss some of the specific issues and problems that seem to me affect the relative success of environmental studies programs at universities. I realize that a given university must handle these problems in its own time and fashion.

First, I have already argued for a theme, or a set of paradigms. I would not restrict all activities in an environmental studies program to some tightly defined mathematical set of relationships. However, I do feel a theme or set of themes says to the University community, "Here's what we are. And here is what we are not. We are not everything to everybody. We hope we reach you and influence you. But we are not going to take over your discipline like a fast-multiplying virus."

Next, I think it is essential that the environmental studies program have some kind of status in the university hierarchy. Some universities are creating

colleges. Others are assigning some academic prerogatives to environmental studies programs, for example departmental status. Some programs are under academic deans. Others are independent of academic deans and report directly to a Chancellor or Provost. Since faculty control of academic policy varies from campus to campus as compared to administration control, it would be difficult to recommend which configuration would be best across the country.

I would argue, on this point, for some kind of Bill of Rights for faculty in environmental studies.

This Bill of Rights would include the authority to have a budget, the authority to appoint faculty in environmental studies, the authority to teach courses and to grant degrees, and the authority to submit research proposals to funding agencies.

Sometimes these authorities are hard to come by, particularly if a campus is in a budget crunch, as most are. For example, the authority to appoint faculty in environmental studies is a rather startling idea on many established campuses, if not the new ones. Universities, when hiring a new assistant professor, assume he will be around the length of his career. That's an investment of upwards of $600,000. At this moment in history, that money will likely come from one of the established units if the new position is in an interdisciplinary program. On top of that, how does one evaluate a professor of interdisciplinary studies? Quality review systems are geared to the disciplines.

As I look at environmental programs around the country, it appears to me that two groups of people in the academic pyramid are achieving some success. Some of the people have tenure and have announced, "This is what I'm going to do." They tend to have enough respect from their colleagues so that their decision is unchallenged. The other group are those without professorial status and no immediate likelihood of getting it. These are the post-doctorates in the

research organizations or the lecturers who take this route out of conviction. It is, in my opinion, relatively hard for the assistant professor to meet the demands of the discipline and the demands of interdiscipline. I suppose one could argue that it is a very difficult task to expect this from graduate students working on interdisciplinary degrees. At Wisconsin a student can work on a PhD committee degree in Environmental Studies and a professional Law Degree at the same time. Three students have started this route and given it up, returning to the Law Degree. One student first earned a PhD in Biology and is now getting a Law Degree. He will succeed.

Perhaps we cannot expect everything from a person in the formative period of his career. But let us make sure our system is flexible enough so that academic boundaries do not become academic cells; that people can move from one location to another in their careers if they so chose.

I would argue to university administrators that an environmental studies budget is a critical item. In any period of budget constriction, interdisciplinary studies will, almost inevitably, be third or fourth priority if the only avenue of review is the department or discipline. If you cannot wedge out some budgetary security for faculty, you will not sustain such a program. This does not necessarily mean expansive sums of money. Because of the growing importance of the problems, money committed in this direction will have a multiplier effect. Often we have felt that relatively simple problems such as budget transfer have kept talented and enthused faculty from taking part. For example, does a department lose any salary savings it would accrue if a faculty member is budgeted part time and for a short period in an environmental studies program? Logistics can be important.

A third major issue is the format of teaching and the manner in which teachers prepare for interdisciplinary studies. One would hope for a rennaissance

professor, that is, a professor who understands the dialectics of the disciplines, understands the relationships and brings a gestalt meaning to the classroom. Some people can do this. More often we have said to the student, "You listen to us specialists, and then you integrate it." Or we have created specialists among the students unto our own image. I am aware of one interdisciplinary biology program that tells entering freshmen, "Our goal is to start you now, on the track of a PhD in molecular biology." I have no objection to the goal, only to the fact that the mission of the program is to search for the commonalities in biology and the meaning of that to man's existance on earth.

Many environmental studies programs have experimented with visiting lecture courses, and with team teaching. Some universities are experimenting with training programs for their faculty; that is, release time so that faculty can learn together the key concepts, the technical vocabularies and the synthesis possibilities of their disciplines. It may be obvious that I prefer the latter solution to the maturation of faculty in environmental studies. Another route is the case study approach to learning. There are many successful examples of teaching in terms of field examples and case studies. I would argue that this sort of format should normally follow, rather than precede, some organization and synthesis of the concepts of the disciplines.

I have, from time to time, fretted about the laissez faire approach to academia that has evolved in the last several decades in American universities. While I do not argue against the concept of academic freedom in the pursuit of knowledge, and am fully aware of the possibility of breakthroughs in knowledge via unrestricted search, I am also aware that independence of academic action can protect mediocrity, can lead to hair-splitting specialization, and to a breakdown of disciplines with a connotation not normally attributed to universities, that is the discipline required to understand the non-tractable, multi-system problems

like those we encounter in environmental studies.

I do not speak these words from a stance of inferiority complex. I feel there is a place for both the disciplinary and the interdisciplinary role in the university. The latter may be of some urgency for universities to consider more seriously. We have come through the golden age of funding for universities. Disciplinary activity has flourished with many benefits to society. It seems to me that society is now saying go ahead with the search for basic knowledge in constantly refined categories. But it is also saying, "therefore what?" Are the universities addressing some of the basic and fundamental problems of mankind in a way that the investment and expertise would lead us to expect?

To borrow a rather threatening term from ecology, I sometimes feel that the universities have developed their own particular kind of mono-culture. They have self-selected for people who want to pursue their own highly specialized track of discovery, unilaterally, without general review. The image is abroad one "makes it" if he makes it alone. In one university with which I am familiar, a person is judged more by the papers he has authored alone than by the papers he has jointly authored. With several years experience in environmental studies I have noted that faculty and students are attracted to the program by conviction or by the opportunity for funding, but they really aren't prepared intellectually or psychologically for the kinds of confrontation and the energy required. And there is a price in terms of an individual's momentum in his own disciplines. One also gets immersed in the problems of territory and the nagging questions of rigor. What we must preserve is the intellectual confrontation of the disciplines, without getting bogged down in the administrative confrontations. If interdisciplinary scholars avoid the disciplines, they will likely evolve into another layer of disciplinarians. The trick is to provide flexibility in organization without throwing out all the traditional criteria of evaluation

of the disciplines. One of the campuses on my recent tour has discarded most of the trappings of evaluation traditionally used in universities. Theirs is an exciting program. But committees of faculty are busily constructing new sets of rules of behavior in order to deal with their rates of growth and in order to cut down on such figures as 60 student contact hours per week per faculty member.

As I indicated at the start of this presentation I don't think that an environmental studies program conceived exclusively around conservation of resources, or pollution abatement, or environmental impact analysis is enough to keep the program going in a university environment, nor does it address all the questions we need to ask.

Rather we need to ask questions about the causes of our environmental problems and where we want to go. Is a highly-technical society invulnerable to environmental change? Or is it vulnerable? Can we maintain the rates of growth in the United States in the face of increasing pressures from underdeveloped countries and increasing competition from countries with currently rapid rates of growth? What is the real price of pollution over a longer time span than we have hitherto wished to calculate?

My personal assessment is that there are now enough environmental programs around with stature so that the species is not endangered. We have come a long way from E-Day. We are beginning to develop some content which is more than the elucidation of problems. We have made, however, only modest commitments of university resources to program development.

If we can begin to develop some general comprehension of the interrelationship of environmental problems and thus of the disciplines, we will have some chance to affect policy and behavior of society vis-a-vis environmental problems.